Emergence of Mixed Quantum Phases in Spin-1/2 Systems

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The phase diagram of Rokhsar-Kivelson models, which are used in fields such as superconductivity, frustrated magnetism, cold bosons, and the physics of Josephson junction arrays, is revisited. From an extended height effective theory, we show that one of two simple generic phase diagrams contains a mixed phase that interpolates continuously between columnar and plaquette states. Applied to the square lattice frustrated Heisenberg antiferromagnet, we have extended the Rokhsar- Kivelson (RK) loop-expansion to derive a generalized Quantum Dimer Model containing only connected terms up to arbitrary order. Our results suggest that the Heisenberg model is a physical realization of such a mixed phase, in the parameter region of maximum frustration.